April 22, 1941. W. MULLER ET AL 2,238,944

CONCRETE CONVEYING APPARATUS

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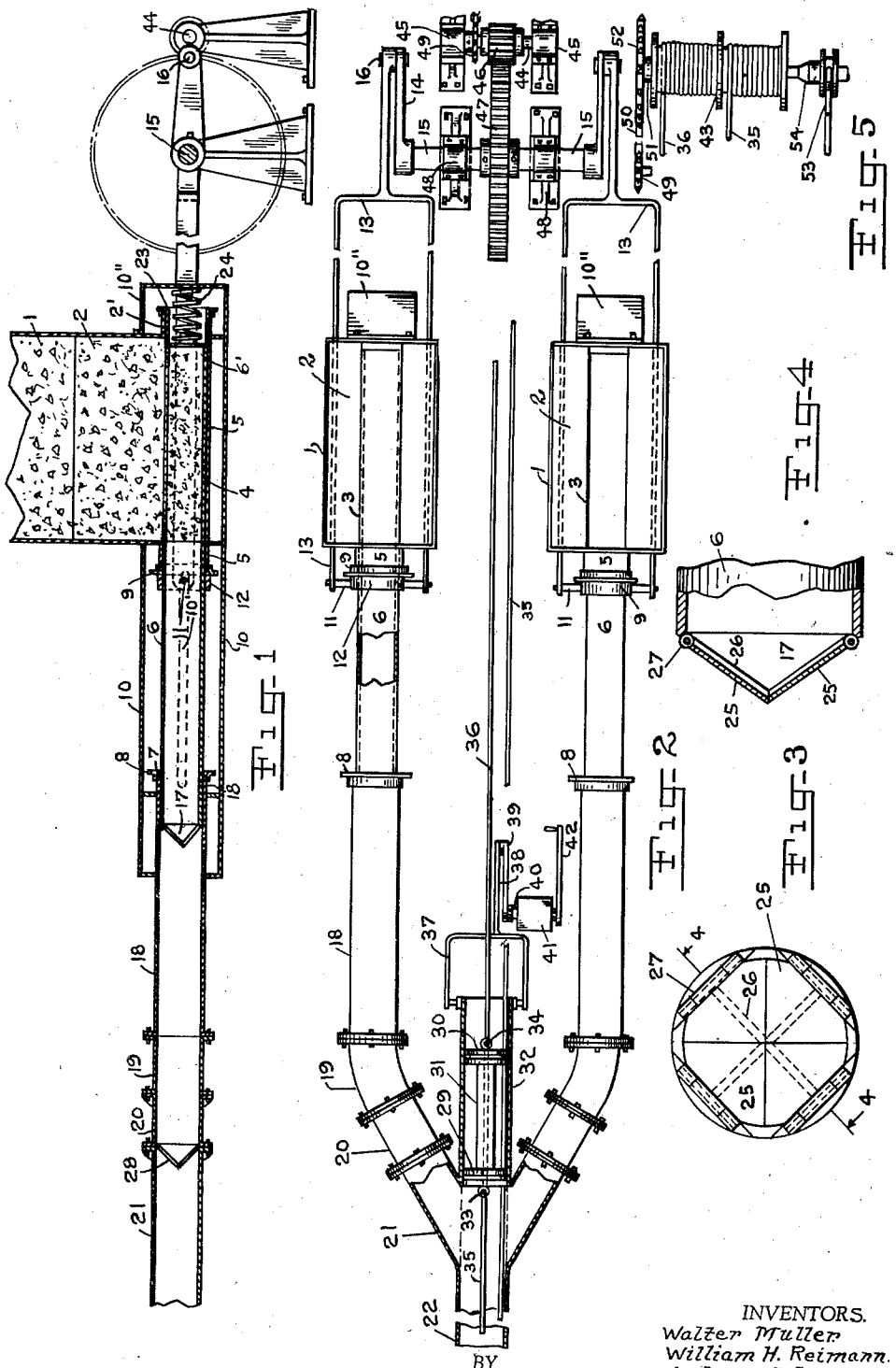


FIG-1

FIG-2

FIG-3

FIG-4

FIG-5

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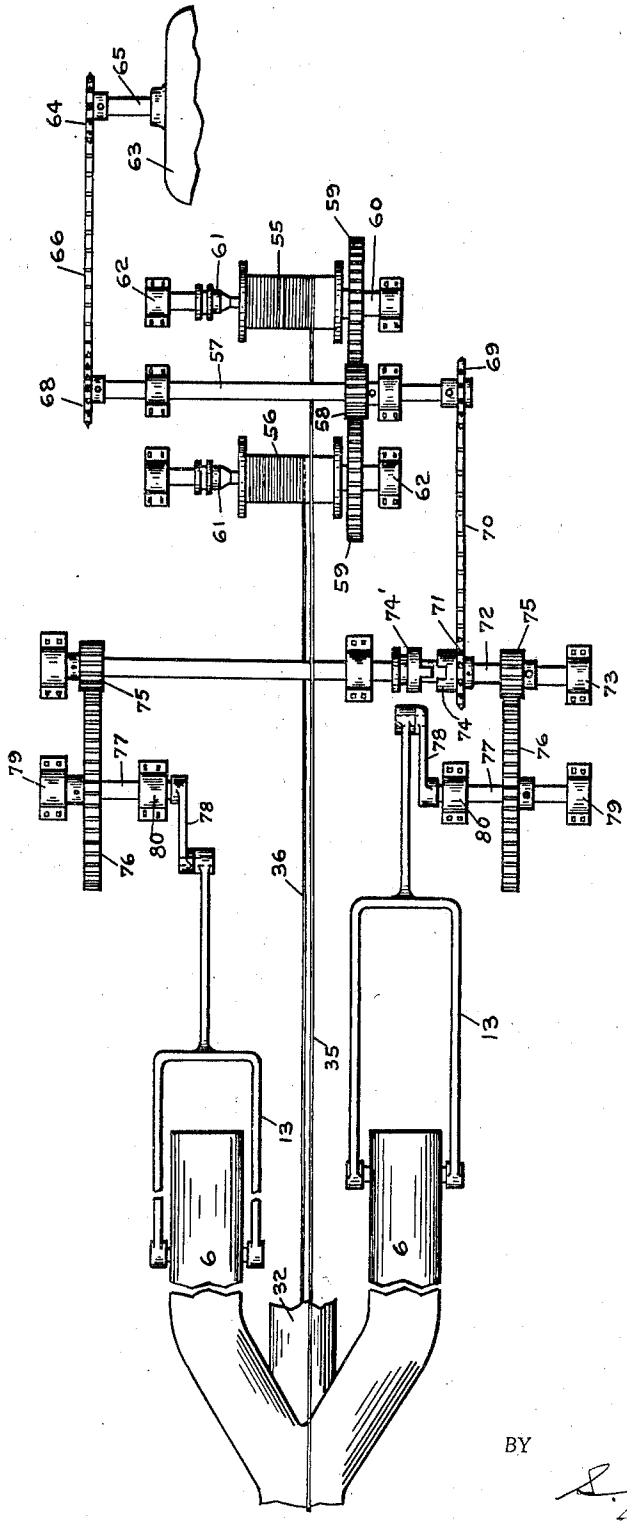


FIG. 6

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CONCRETE CONVEYING APPARATUS

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Application May 24, 1938, Serial No. 209,654

16 Claims. (Cl. 198—59)

The improvements relate primarily to apparatus for conveying wet or plastic concrete or the like, but may be employed for other purposes to which they are adaptable, and among their objects are the provision of means for taking up and conveying the freshly mixed concrete aggregates and conveying them through a conduit to distant points horizontally and vertically by mechanical means alone or by mechanical means actuated by fluid under pressure, effectively and economically with respect to power employed, apparatus and its upkeep and labor employed in operation. Other objects and advantages will be apparent from the following description.

Three methods of conveying plastic concrete through extended conduits have heretofore been employed: first, the use of compressed air behind a mass in a large container to force it into and through the conduit, with the aid of a jet at the outlet from said container into the conduit to break it up into sub-masses and propel them through the conduit; second, the use of a pump of the piston type arranged to act behind the mass as it passes from the container and push it into and through the conveying conduit by mechanical pressure, the container outlet and conduit having alternately acting valves to prevent the concrete from being forced back into the container on the forward stroke of the piston or plunger and to prevent the concrete in the conduit from moving backward with the backward stroke of the poston; and third, the propulsion of the concrete from the container through the conduit by buckets strung on an endless cable running through the conduit and back in a path exterior thereto and driven by a powered wheel or wheels over which said cables and buckets pass. All these methods are attended by difficulties of operation or maintenance or unsatisfactory results when employed for some purposes. Thus, the compressed air method requires a very large volume of air under pressure, and usually delivers the concrete at the discharge end of the conduit with great force, the piston pump method involves very high pressures in the conduit and high power to maintain such pressures and requires constant attention and much servicing, while the chain and bucket method is attended with the disadvantage resulting from the employment of a long and easily impaired continuous line of propelling means operating against high resistance in the materials.

The present improvements are designed to overcome the difficulties and remove the objections to the conveying means referred to, and all other conveying means, and in the preferred embodiment employ a hollow piston open at its rear end and mechanically reciprocated in a chamber of the bin or other container and having an automatic valve head at its forward end, so that on the backward stroke it passes through and shears off a slug of the concrete in said chamber, receiving it within itself, and on the forward stroke carries it into the conveying conduit, at the same time pushing forward through the said conduit the preceding slug and the column of materials ahead of it while at each backward stroke its valve head opens to discharge the slug last carried forward by it through the resitsance of the concrete in the discharge chamber of the hopper which compels the said slug to remain substantially stationary while the hollow piston is retracted to cut off and receive another slug. The ability of the piston to discharge the slug of concrete therein on its backward stroke and propel forward the slug ahead of it on its forward stroke is due to the provision of a head consisting essentially of the sectors of a disk hinged near the periphery of the piston at its forward end and free to be opened by internal pressure and to be closed by external pressure, so that when the piston moves backwardly these valve head members permit the slug in the interior to pass therethrough and be discharged and on the forward stroke of the piston close and prevent the material ahead from entering so that it is driven forward. The piston or plunger and the section of the conduit in which it reciprocates are preferably round in cross section, but may be rectangular or of other shape if desired.

In the operation just described the concrete in the hopper moves down into and fills the discharge chamber as the plunger passes therefrom, so that when the plunger returns the slug in the piston is prevented by this material in the chamber from moving backward therewith, and is consequently expelled from the piston. If, however, the material in the hopper yields to some extent no harm results therefrom, the effect being merely to prevent a complete discharge of the entire slug in the cylinder, and to some extent reduce the compactness of the mass therein; and if the valve head does not close quickly or completely on the forward movement, the only effect is to reduce to some extent the amount of material pushed forward ahead of the plunger. Both actions have a tendency to prevent jamming of the concrete and reduce friction and wear of the parts, and merely lessen to some extent the rate of discharge and conveyance.

The improvements also include, in addition to certain structural features, auxiliary means for propelling the concrete through the conveying conduit and discharging it comprising a cable running through the conveying conduit and mounted to be wound on a winch at one or both ends, with a piston device carried thereby. It is contemplated that the piston device or "traveling plug" shall be propelled by fluid pressure behind it instead of being drawn through the conveying conduit by the cable and that in such case only a retracting cable, wound on a power drum or the like, to draw it back through the said conduit to its "home" position shall be employed, this drum being controlled in its unwinding operation by a brake, so that the speed of the plug and the consequent speed of the concrete under the fluid pressure can be kept within safe bounds. A cable running entirely through the conduit at all times, and extending from both ends of the plug may however be used, and this may be wound on drums at one or both ends of the conduit by power means located at such ends, to propel it both forward and backward, or the cable may be endless, extending back to the propelling device at the charging end of the conduit from its discharge end, exterior thereto, so as to provide a revolving travel of the plug in one direction. In any arrangement of the plug, it may be employed to propel the concrete which has been forced into the conveying conduit by the mechanically operated reciprocating pistons through said conduit and to the point of discharge. It may also be employed to lubricate the conduit by carrying a suitable lubricant, before the conveying operation is instituted, after which the liquid content of the freshly mixed concrete will serve as a lubricant. The traveling plug may also be employed to propel concrete to and through a conveying conduit independently of other means, and in this case, and in the other manner of use indicated, a series of plugs arranged to be picked up in succession by the cable so as to propel a batch of concrete in successive slugs, one ahead of each plug, may be employed.

In the accompanying drawings, Fig. 1 is a vertical section, partly in elevation, of one of the duplicate hoppers and discharging and conveying devices with a portion of the common conveying conduit and of the common power operating means;

Fig. 2 is a plan of the said duplicate discharging and conveying means and the supplemental cable operated conveying means with the common power operating means for all;

Fig. 3 is an enlarged plan of one of the automatic valve heads of the hollow cylindrical pistons;

Fig. 4 is a medial section thereof, on the line 4—4 of Fig. 3;

Fig. 5 is a plan of the cable drums and power connection;

Fig. 6 is a plan of another form of the cable drums and power transmitting devices.

In the said drawings, which show an exemplary embodiment of the improvements, 1 is a hopper or bin for receiving and holding a batch of mixed plastic concrete and having a lower reduced portion 2 with substantially vertical walls open at the bottom, as indicated at 3, for the discharge of the concrete into the receiving chamber 4, of the cylinder 5, open at its upper part to receive it, on which the hopper is mounted.

The hollow piston-conveyor 6 is mounted to slide in the cylinder 5 and has a stroke about equal to the length of the discharge opening. It has packing rings 7 between it and the annular collars 8 and 9 by which it is mounted to slide in the stationary sleeve 10 which supports the forward end of the cylinder 5 and the end section 18' of the conduit. Laterally projecting pins 11 on opposite sides of the collar 12 fixed to the piston conveyor 6, connect the said piston with the bifurcated piston rod 13 operated by the crank 14 keyed to the shaft 15, and in this manner the said piston is connected with power transmitting mechanism. The rotation of the shaft 15 imparts to the piston member 13 reciprocating movement, through the crank 14 and crank-pin 16, which causes the piston 6 to move backward and forward, a distance equal to the diameter of the circle described by the crank. This stroke of the piston may be varied by substituting a longer or shorter crank as desired within the limits prescribed by the parts in which the piston reciprocates, in the present case a little less than half the length of the piston. The head 17 of the piston projects into the straight section 18 of the conveying conduit which is connected by the elbow section 19, and straight section 20 to the Y section 21 of the conveying conduit leading to the main conduit 22, which may be of any desired length required to deliver the concrete at the point of final discharge and placement. The conveying and propelling means here described are duplicated for each branch leading to the Y 21, and this increases the capacity and effectiveness of the apparatus, the two columns of concrete converging at the Y and moving in a substantially solid column through the main conveying conduit 22. Where the nature of the work permits it, however, a single conveying and propelling unit may be employed instead of the twin units, and where the latter are used the main conduit and the portion of the Y which discharges into it may be of greater diameter than the branching conduits.

To insure against injury to the piston or connecting rod 13 and piston head 17, should the piston jam or the column of concrete become blocked each branch of the piston rod may be made with a conventional type of yieldable rod and receiving the other section telescoping therein, so that unusual resistance will cause the piston rod to be reduced in length a sufficient extent to take up the forward movement of the crank 14. This will also take care of block or jam on the opposite stroke. But this provision is not necessary if the apparatus is carefully operated and controlled, and other protecting means—such as a slip clutch—may be provided if desired.

The pins 11 work in longitudinal slots in the sleeve 10 indicated at 10' (Fig. 1), of a sufficient length to permit the full movement of the piston rod. At the rearward end of the cylinder 5 there is provided a buffer housed in the capped end 10'' of sleeve 10 and comprising the hollow plug 23 movable in the annular flange 2' on the hopper part 2 surrounding it and normally held in its forward position by the compression spring 24. In this manner injury to the open end of the piston by concrete lodging between it and the rear wall of the cylinder is prevented.

The piston 6 is preferably made of steel and is of substantial thickness and sufficient strength to resist all pressure and other strains to which it is subjected, its rear end being open, as indicated at 6'. Its forward end is provided with the valve head 17 which consists of sectors 25 of a

conical disk hinged on the outer edges of the cylinder, as shown at 27. The opposed edges of these sectors may be slightly beveled to permit them to open and close freely in the concrete and have ribs or flanges 26. When open they are substantially aligned with the walls of the cylinder, projecting outwardly therefrom, and when closed they form an effectively sealed head with their abutting edges in contact or substantially in contact. Any sand or cement lodged between these edges will not prevent an effective closure. When the hollow piston 6 becomes filled with concrete, this concrete will be forced through the head 17 on its backward stroke, due to the concrete in the cylinder at the bottom of the hopper preventing the same from moving backward with the piston, the valve members 26 opening to permit its egress through the piston head, and when the piston again moves forward these valve members will close forming a closed piston head and push the concrete forward through the conduit section 18. Repeated strokes of the piston will thus force a colmun of concrete through each branch of the Y of the feeding conduit into and through the main conduit 22 to and through the discharge end of said main conduit, which may be at a point far distant from the piston. When concrete is being forced to a higher level it is desirable to provide against its backing up under the pressure of the column when the piston moves backward, and a valve 28 of substantially the same construction as the valve head 17 is therefore provided at the forward end of the conduit section 20 to act as a check valve. This check valve is also useful when the concrete is being conveyed horizontally, as the backward movement of the piston may cause a certain degree of suction. Similar valves may also be located in conduit 22.

The operation of the piston in cutting off on its backward stroke and carrying forward on its forward stroke a slug of concrete is one of the important functions provided by the present improvements, as this substantially prevents pressure on the contents of the hopper and bin and does away with the need for a valve device of any kind between the piston and the hopper. It also relieves these parts of pressure and confines the pressure to the conduit beginning at a point removed from the hopper and its adjacent parts. The concrete is thus permitted to gravitate to the bottom of the hopper and into the cylinder freely when the piston is going forward so that the piston on its return stroke will cut through and bite off a substantially solid slug. The substantially vertical walls of the bottom section 2 of the hopper are spaced apart a distance approximately equal to the width and length of the cylinder, and this provides a column of concrete of substantial height bearing on the cylinder without constriction so that the concrete will gravitate quickly and freely into the said cylinder as the piston passes therefrom. Nevertheless, the concrete will not have an opportunity to jam and form a compact mass at the mouth of the cylinder, because the cylinder returns quickly from its forward stroke, and this permits its rear edge to cut through the concrete in its path and bite off a slug without undue friction or resistance by the concrete.

At the end of a day's operation one of the conduit sections between the piston and the main conduit may be removed and the hopper and adjacent conduit sections easily cleared of concrete standing therein.

Where the point of discharge of the concrete is at a great distance from the conveying and propelling means it is desirable to have additional means for propelling the concrete and this is provided by the traveling plug and its operating means. The said plug consists of two disks 29 and 30 connected by a substantially rigid shank 31 normally located in an open ended cylinder 32 mounted at the crotch of the Y in the feeding conduits and having eyes 33 and 34 to which are secured cables 35 and 36. When the traveling plug or plunger is used it is desirable to close off the branches of the Y, and for this purpose the cylinder 32 is slidable to a position (see dotted lines, Fig. 2) in which it forms a closure for these feeding conduits. This movement of the cylinder is provided for by a bail 37 secured to the rear end of the cylinder 32 operated by a link 38 and crank 39 mounted on a short shaft 40 in a bearing 41 adapted to be rocked by a hand lever 42. This cylinder also directs the plug into the conduit 22.

The cables 35 and 36 are wound on the power operated double drum 43 (Fig. 5) to advance and retract the plug, but a single drum (not shown) may be located at the discharge end of the conveying conduit if desired to pull the plug forward through the conduit and force ahead of it the concrete therein. In the latter case a single drum may be used to wind the cable 36 instead of the double drum 43.

The power mechanism comprises a power shaft 44 mounted in suitable bearings 45, a pinion 46, on the shaft meshing with a large gear 47 keyed on the shaft 15 mounted in bearings 48. This provides for the power operation of the pistons.

The power for winding the drum 43, located behind the pinion 46, comprises a sprocket 49 on the power shaft 44 and connected with the drum shaft 51 through sprocket 52 thereon by a sprocket chain 50 said sprocket 52 connecting with the drum (Fig. 5) through a friction clutch 54 operated by clutch lever 53 so that when the cable is to be wound the drum can be connected with its power shaft through said clutch. The drum shaft 51 and its driving sprocket 52 are mounted in suitable bearings (not shown).

The drum at the outer end of the conduit may be operated by an independent motor, or the cable 35 may be run over suitable pulleys or sheaves back to the drum 43 and connected with said drum to wind when the cable 36 unwinds and vice versa.

In the embodiment of Fig. 6 two separate drums 55 and 56 are provided, one for the cable 35 and the other for the cable 36, and these are connected with a drum power shaft 57 through the gear 58 on said shaft and the larger gears 59 on the shafts 60 of the drum and through friction clutches 61 to connect said drums with their shafts, the shafts 60 being mounted in suitable bearings 62. The motor or other power device 63 has a sprocket 64 on its shaft 65 which connects it through the sprocket chain 66 with the shaft 57 through sprocket 68 on said shaft. On the opposite end of said shaft is keyed a sprocket 69 connected by sprocket chain 70 with sprocket 71 on shaft 72 mounted in bearings 73, and this shaft 72 is connected with sprocket 71 through a jaw clutch 74, 74', so that the pumps may be disconnected from the power when the drums are operated, and vice versa. In this case the pumps are driven from the shaft 72 through the pinions 75 thereon meshing with large gears

76 on shafts 77 of the cranks 78. Suitable bearings 79 and 80 are provided for the shafts 77.

As before noted, the traveling plug may be propelled through the conduit if desired by compressed air, and in this case the cable 35 will be omitted, and the cable 36 used to control the speed of the plug and the resulting speed of the concrete propelled thereby, and to retract the plug after it has traveled to the end of the conduit and discharged the concrete therein. As also before noted, the plug may be used to lubricate the conduit before starting the conveying operation. It is also useful in cleaning out or swabbing the conduit when the conveying operations are to be suspended. To facilitate the travel of the plug through the conduit and around curves and bends thereof its rear member 30 is slightly less in diameter than the forward member 29 so that it does not fit the conduit tightly.

What we claim is:

1. In apparatus of the character indicated, a hollow open ended piston-like device constructed and arranged to receive materials, power means for reciprocating the same, a cylindrical member in which said device reciprocates, a receptacle for material to be conveyed having a discharge opening therein, said cylindrical member being in communication with the discharge opening of the receptacle and said device being mounted to reciprocate across said receptacle opening.

2. In apparatus of the character indicated, a hollow open ended piston-like device, power means for reciprocating the same, a cylindrical member in which said device reciprocates, a receptacle for material to be conveyed having a discharge opening therein, said cylindrical member being in communication with the discharge opening of the receptacle and said device being mounted to reciprocate across said receptacle opening, a valve head at one end of said device the other end being open to permit said device to pass through and take in material in the cylindrical member.

3. In apparatus of the character indicated, a hollow open ended piston-like device, power means for reciprocating the same, a cylindrical member in which said device reciprocates, a receptacle for material to be conveyed having a discharge opening therein, said cylindrical member being in communication with the discharge opening of the receptacle and said device being mounted to reciprocate across said receptacle opening, and a conveying conduit in communication with and extending away from said cylindrical device.

4. In apparatus of the character indicated, a hollow open ended piston-like device, power means for reciprocating the same, a cylindrical member in which said device reciprocates, a receptacle for material to be conveyed having a discharge opening therein, said cylindrical member being in communication with the discharge opening of the receptacle and said device being mounted to reciprocate across said receptacle opening, a valve head at one end of said device the other end being open to permit said device to pass through and take in material in the cylindrical member, a conveying conduit in communication with and extending away from said cylindrical member and a check valve device in said conduit.

5. In apparatus of the character indicated, a hollow open ended piston-like device, power means for reciprocating the same, a cylindrical member in which said device reciprocates, a receptacle for material to be conveyed having a discharge opening therein, said cylindrical member being in communication with the discharge opening of the receptacle and said device being mounted to reciprocate across said receptacle opening, a conveying conduit in communication with and extending away from said cylindrical member and a plunger device mounted to travel through said conduit in both directions.

6. In a device of the character described, a conduit, means for charging the same with materials to be conveyed therethrough comprising branch conduits merging in a single conduit, a piston device mounted to reciprocate in each branch near the charging end thereof and to force materials therethrough and a traveling plug member mounted adjacent the merging point of said branch conduits, means for causing said member to travel through said single conduit beyond said piston devices and to force materials therethrough.

7. In a device of the character described, a conduit having branches, means for charging the branches with materials to be conveyed therethrough comprising piston devices mounted to reciprocate in said branches and to force materials therethrough, and a traveling plug member mounted adjacent the junction of said conduit and its branches, means for causing said member to travel through said conduit beyond said piston devices and to force materials therethrough, said last means comprising a cable secured to said device, a drum for winding said cable and power means for operating said drum.

8. In apparatus for conveying solids in a divided state, a conduit, a receptacle for the material, said conduit having an opening into the receptacle for the passage of material from one to the other, a hollow member mounted to reciprocate across the opening in the conduit, means for reciprocating said member in the conduit, a closure at one end of said member the other end thereof being open, the construction and arrangement being such that it passes through material which has passed into said conduit from said receptacle, receives such material in its bore, and then carries it away from the receptacle.

9. In apparatus for conveying solids in a divided state, a conduit, a receptacle for the material, said conduit having an opening into the receptacle for the passage of material from one to the other, a hollow member mounted to reciprocate across the opening in the conduit and constructed to open and close the same, means for reciprocating said member in the conduit, a closure at one end of said member the other end thereof being open, the construction and arrangement being such that it passes through material which has passed into said conduit from said receptacle, receives such material in its bore, and then carries it away from the receptacle.

10. In apparatus for conveying solids in a divided state, a conduit, a receptacle for the material, said conduit having an opening into the receptacle for the passage of material from one to the other, a hollow member mounted to reciprocate across the opening in the conduit, means for reciprocating said member in the conduit, said member having an opening at one end to permit said material to be received in its interior, and carried by it in a direction away from said openings.

11. In apparatus for conveying solids in a divided state, a conduit, a receptacle for the mate-

rial, said conduit having an opening into the receptacle for the passage of material from one to the other, a hollow member mounted to reciprocate across the opening in the conduit, means for reciprocating said member in the conduit, a closure at one end of said member arranged to be opened and closed by reciprocating of said member in contact with the material alternately, the opening being on movement of the same backward across said opening and the closing on movement forward.

12. In apparatus for conveying solids in a divided state, a conduit, a receptacle for the material, said receptacle and conduit having an opening for the passage of material from one to the other, a hollow member mounted to reciprocate across the opening, means for reciprocating said member in the conduit, a valve device at one end of said member and a valve member in said conduit beyond the path of said hollow member, said hollow member embracing material on movement in one direction and conveying such material and propelling other material ahead of it on movement in another direction, and on movement in the first direction its valve device permitting material to pass the same.

13. In apparatus for conveying solids in a divided state, a conduit, a receptacle for the material, said receptacle and conduit having an opening for the passage of material from one to the other, a hollow member mounted to reciprocate across the opening in the conduit, and to open and close the same, means for reciprocating said member in the conduit, said member having an opening at one end to permit said material to be received in its interior on one movement and carried forward by it on the other movement, a valve device at one end of said member arranged to be alternately opened and closed by reciprocation of said member in contact with the material.

14. In apparatus of the character indicated, a hollow open ended piston-like device constructed and arranged to receive materials, power means for reciprocating the same, a cylindrical member in which said device reciprocates, a receptacle for material to be conveyed having a discharge opening therein, said cylindrical member being in communication with the discharge opening of the receptacle along the path of the piston-like device and said device being mounted to reciprocate across said receptacle opening and to open and close the same.

15. In apparatus of the character indicated, a hollow open ended piston-like device, power means for reciprocating the same, a cylindrical member in which said device reciprocates, a receptacle for material to be conveyed having a discharge opening therein, said cylindrical member being in communication with the discharge opening of the receptacle and said device being mounted to reciprocate across said receptacle opening, a valve in said device constructed to open automatically on one stroke to permit said device to pass through and take in material in the cylindrical member and to simultaneously discharge material previously taken therein.

16. In apparatus of the character indicated, a hollow open ended piston-like device, power means for reciprocating the same, a cylindrical member in which said device reciprocates, a receptacle for material to be conveyed having a discharge opening therein, said cylindrical member being in communication with the discharge opening of the receptacle and said device being mounted to reciprocate across said receptacle opening, a valve in said device constructed to open automatically on one stroke to permit said device to pass through and take in material in the cylindrical member and to simultaneously discharge material previously taken therein and said valve also constructed to close automatically on the opposite stroke and propel materials previously discharged therefrom.

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